

Summary Notes from 5 March 2008 Generic Technical Issue Discussion on Long-Term
Grout Performance

Attendees: Representatives from Department of Energy-Headquarters (DOE-HQ) and the U.S. Nuclear Regulatory Commission staff (NRC) met at the DOE offices in Germantown, Maryland on 5 March 2008. Representatives from Department of Energy-Savannah River (DOE-SR), Department of Energy-Idaho (DOE-ID), Department of Energy-Richland (DOE-RL), Department of Energy-River Protection (DOE-ORP), and the Center for Nuclear Waste Regulatory Analysis participated in the meeting via a teleconference link.

Discussion: NRC Staff prepared and disseminated a paper summarizing issues and considerations relative to grout degradation and associated modeling issues. The purpose of this meeting was for DOE and NRC staff to discuss the issues and considerations raised by NRC in the context of generic approaches for establishing long-term grout performance unrelated to any specific waste determination or pending DOE action.

Topics: The following three specific topical areas were discussed during the meeting:

1. Limited data for actual materials
2. Lack of consideration of real features
3. Additional conceptual model or model abstraction limitations

Summary: The following summarizes the discussion and the principal points of technical understanding identified during the meeting, unless otherwise noted.

Limited data for actual materials

- NRC provided an overview of their position paper on the topic of limited data for actual materials. NRC staff noted that materials such as grout are relatively easy to characterize under laboratory conditions, but may not perform the same under actual conditions as in the laboratory. Being able to characterize the actual performance of materials outside the laboratory may be difficult for a variety of reasons. NRC staff noted that under such

circumstances it may be acceptable to use surrogates with similar additives and formulas that are placed under similar conditions as the actual grout.

- NRC staff noted that it is important to be able to understand how a waste form evolves (e.g., cracking, ability to maintain oxidizing conditions) and that having a better understanding of the initial conditions can provide a better understanding of long-term performance.
- NRC staff noted that some performance assessments look at the performance of Portland cement, but some formulations used by DOE have other components and additives that are often used in the grout formulation. It is not always clear whether the impacts of the formulations and additives upon long-term performance have been adequately assessed.
- DOE questioned whether taking a few field samples and correlating them back to laboratory samples would be an acceptable way to establish the link for long-term performance comparability. NRC staff agreed that this approach can be used successfully, but that care must be taken to ensure that the situations are comparable. NRC staff also noted that taking a sample from each layer of poured grout could be helpful, at a minimum, to help with characterization of actual grout materials. Laboratory experiments can also be completed to determine the importance of scale effects,
- DOE noted that it is necessary to minimize exposures when sampling actual grout (with radionuclides) and that there may also be issues with analysis of those samples. NRC staff noted that some optimizing of ALARA concerns versus the need for characterization data might be appropriate. However, in most cases there are options available to analyze samples taking into account radiological safety. For example samples can be taken from layers of grout without radioactivity and then laboratory experiments can be done to determine the effects of radioactivity on grout properties. In other circumstances, the benefit of the taking radioactive samples should be weighed against the potential for significant public exposure in the future due to higher than intended grout degradation. As such, ALARA concerns should not be used as the sole basis for not taking in-place samples. NRC staff also noted that DOE has extensive experience performing analysis and characterization of radioactive samples, such as samples of high-level waste glass and spent nuclear fuel.

- NRC staff noted that often the people who operate a waste facility are different than the ones who prepared the performance assessment. Sometimes operational decisions may be made, e.g., switching to a new additive, without recognizing the implications for grout performance. DOE noted that they are addressing this configuration management issue to prevent this type of disconnect between the performance assessment and operations.
- NRC staff noted that it is important to ensure that samples are representative, both in terms of the grout material as compared to the actual grout and in terms of the conditions under which it is expected to perform.
- DOE noted that traditionally its performance assessments have relied on generic information and that it has used its maintenance program to develop more detailed information on actual performance. DOE indicated that when preparing a performance assessment they should take into consideration the ability to collect information to improve understanding of long-term performance once operations begin. NRC staff agreed that it is important to be able to confirm assumptions that are made in the performance assessment with actual performance information. There is a difference between assuming performance and demonstrating performance with some assumptions that are later verified. Generic information should be used cautiously for parameters in the performance assessment. If the parameters are key to demonstrating performance, their values should be verified.
- DOE questioned whether it would be useful to provide NRC with the performance assessment maintenance plan when it submits a performance assessment for review. NRC agreed that this would be useful to the extent it addresses how DOE intends to manage the uncertainties.

Lack of consideration of real features

- NRC staff provided an overview of their position paper on the topic of lack of considerations of real features (e.g., cracking, shrinkage, presence of piping). NRC staff noted that this is equally or more important than limited data for actual materials. The process of simplification creates an uncertainty. DOE needs to represent the effects of the real features of the system in the performance assessment even if the real features aren't explicitly represented in the analysis.

- NRC staff noted that the significance of these effects may be different for different facilities, and they need to be addressed specific to the system being evaluated. For example, tanks have lots of piping going in and out, and the model simplification needs to make sure that the impact of the piping has not been simplified away.
- DOE asked whether the approach to failure modeling they are pursuing is addressing this. NRC staff noted that it can provide information as to the significance of the real features and scenarios, but that ultimately adequate basis is needed whether the features and scenarios should be part of the base case or whether they are unexpected conditions. Without information to demonstrate they are unexpected, they should be part of the base case analysis (i.e. compliance case). Justification for not including such real features in the base should be provided.
- NRC staff noted that multiple independent barriers or processes can greatly reduce the probabilities in overall scenarios. If some of the processes or barriers are dependent, then it becomes more difficult. Scenarios that reflect dependent processes are more difficult to address.
- DOE noted that these effects may vary from tank to tank also. NRC staff noted that when there are these types of dependencies, then it is important to analyze those situations appropriately. If you analyze those situations as independent when they are dependent, then you may not realize the importance of the information. This is a situation where observables and real tangible data would be useful in constraining estimates of future system performance.
- NRC staff noted that they have tried to encourage looking at other similar materials, e.g., other concrete structures that have been exposed to years of weathering.
- DOE inquired whether it is reasonable to provide an envelope that adequately addresses these features. NRC staff noted that it would be more reasonable than trying to artificially model the effects without having justification for those assumptions.

Additional conceptual model or model abstraction limitations

- NRC staff provided an overview of their position paper on the topic of additional conceptual model or model abstraction limitations. Some of the information presented was related to issues already discussed. The key was that modeling should not be simplified solely because that is what could be accomplished in the time given. Modeling needs to be commensurate with need and risk significance.
- NRC staff noted that this includes lack of consideration or coupling of physical and chemical mechanisms that synergistically affect degradation rates, lack of consideration of thermal excursions during curing that may affect proliferation of cracking and presence of preferential flow through the stabilized system, lack of consideration of spatially or temporally variant material properties or boundary conditions, and unsupported models to predict transport of deleterious species into the stabilized waste form (e.g., transport of aqueous phase oxygen in a saturated system to predict oxygen).
- NRC staff also noted that conceptualization of a problem is hindered by lack of consideration of site-specific conditions including the actual service environment in which degradation occurs.
- NRC staff noted that relying on the way something was modeled in the past is not necessarily good support if there is not adequate support for the way the problem was originally modeled.
- NRC staff noted that DOE does need to address the issue of alternative conceptual models and will be limited by the data that it has to support these models. May need to capture the more pessimistic cases.
- DOE noted that addressing these issues may require more modeling runs than have traditionally be done.
- NRC noted that rather than mechanically picking each model to apply in alternative conceptualizations, it can be accomplished by allowing the probabilistic platform to pick the configurations, thus also building in the appropriate model uncertainty into the end results. As an alternative, the conceptual model may be related to experimental results to verify and constrain the model results.

- NRC staff noted that a reasonable deterministic analysis supposes that there is adequate support for what constitutes a reasonable assumption.
- NRC staff noted that once the analysis is completed, there is need for interpretation and integration of the results. Interpretation of these results may reflect back on the adequacy or accuracy of the model.
- NRC staff noted that if a system has fractures that water can flow through to get to the waste area, the release of the waste may be controlled by the modification of the water by the grout overlying the waste. Observations have suggested that the reactive surface area of the fractures is much less than the bulk grout, potentially leading to a reduced capacity to modify the chemistry of infiltrating water compared to assumed porous flow. DOE needs to provide adequate justification for the conceptual models used and demonstrate how uncertainty in those conceptual models was considered.

Conclusions and Actions:

- DOE plans for limited data for actual materials: DOE will develop a more focused approach to identifying the sampling and analysis that would be used to support performance assessments, and link it to its performance assessment maintenance process.
- DOE plans for lack of consideration of real features: DOE will ensure that it fully describes the features, show how they were considered in the modeling, and/or provide a basis for the lack of inclusion of the features in the modeling.
- DOE plans for additional conceptual model or model abstraction limitations: DOE will develop technical bases to demonstrate that conceptual models used to model performance and degradation of cementitious systems adequately represent or bound the expected behavior of the real system.